

# Coronavirus Mitigation Cost/Benefit Analyses

The McIlvaine Company has been helping suppliers of flow and treat products and services since 1974 providing specific services on cleanroom apparel, air filters, treatment chemicals and masks. The orientation from day one was to understand the total cost of ownership (TCO) with the realization that the most profitable market for clients was where they had the lowest total cost of ownership (LTCO).

Many Fortune 500 clients have funded our studies on TCO with the goal of providing the best products. This funding has led to the development of a common metric to measure all harm and good.

In the 1980s two of the worlds largest instrument companies developed systems to measure multiple pollutants and make decisions based on the aggregate contamination. For them McIlvaine developed a common metric so that for example determining whether decreasing NOx while increasing CO was beneficial.

This common metric proved inadequate in an assignment for one of the world's largest healthcare companies who wanted to evaluate reusable vs single use surgical gowns. The result was a metric which takes into account comfort and other life quality aspects. It also takes into account tribal values and future value discounts. This metric is ideal for coronavirus decision making. <http://home.mcilvainecompany.com/index.php/markets/air/82ai-coronavirus-market-intelligence>

McIlvaine is working with the suppliers to help them determine which of their products can be best applied to cost effectively mitigate coronavirus.

This is being done on an accelerated basis similar to a McIlvaine initiative after the BP oil spill to determine the best D.O. analyzer to use in the underwater drones to track the spill magnitude.



All the proactive solutions to mitigate the coronavirus can be evaluated based on a common metric to measure all harm and good. This takes into account discomfort of wearing masks, social distancing and other initiatives which impact life quality.



## Benefits

The benefits have to be based on life quality for individuals. The medical community uses Quality Adjusted Life Years. A decision of who gets the ventilator depends on the expected remaining life of the patients. So a young prison inmate serving a life sentence and on a suicide watch would get the ventilator while an older happy member of society would not. There is a better metric which is called Quality Enhanced Life Days (QELD)

## Cost

The cost in dollars can be converted into life quality benefits depending on how funds are distributed. A direct payment to all citizens versus a tax reduction for the wealthy result in different QELD numbers.

All costs and benefits have to be adjusted based on tribal values (my country or the world) and future value discount (raise debt now and pay later).

One economist estimates the present economic cost of the coronavirus at \$10 million per minute. But the social cost is also significant. The social distancing alone has a negative impact on life quality for billions of people around the world.

The decision to implement a specific mitigation technology has to be evaluated based on both its economic and social impact. The simple analysis considers only the cost versus the number of infections eliminated. Using this narrow definition there is no cost to social distancing. The medical community and environmental protection agencies use a life value which is often pegged at \$10 million. This would justify an investment of \$10 million per minute (\$5.3 trillion per year) to save 526,000 people per year. Lets assume that these people would live 50 more years. So this investment pays off to the tune of 26.3 million life years.

In terms of social distancing cost it is necessary to determine for each individual the ratio of life quality with and without social distancing. An individual might be willing to trade 1.1 years with social distancing for one year without it. If this involves 5 billion people then it would total 500 million life years (or 20 million life years for two weeks).

These are not abstract ratios. They are the way we all live our lives. Instead of living to 100 and never be in a car or social gathering or never eat sweets and drink liquor we choose to do these things and only live to be 80. So we have attached a life quality bonus of 25% to live our more reckless life style. So the willingness to trade 1.1 years with social distancing for 1 year without has already been demonstrated.

The CDC estimates that between 12,000 and 61,000 deaths annually since 2010 in the U.S. were caused by the flu.. Globally, WHO estimates that the flu kills 290,000 to 650,000 people per year.

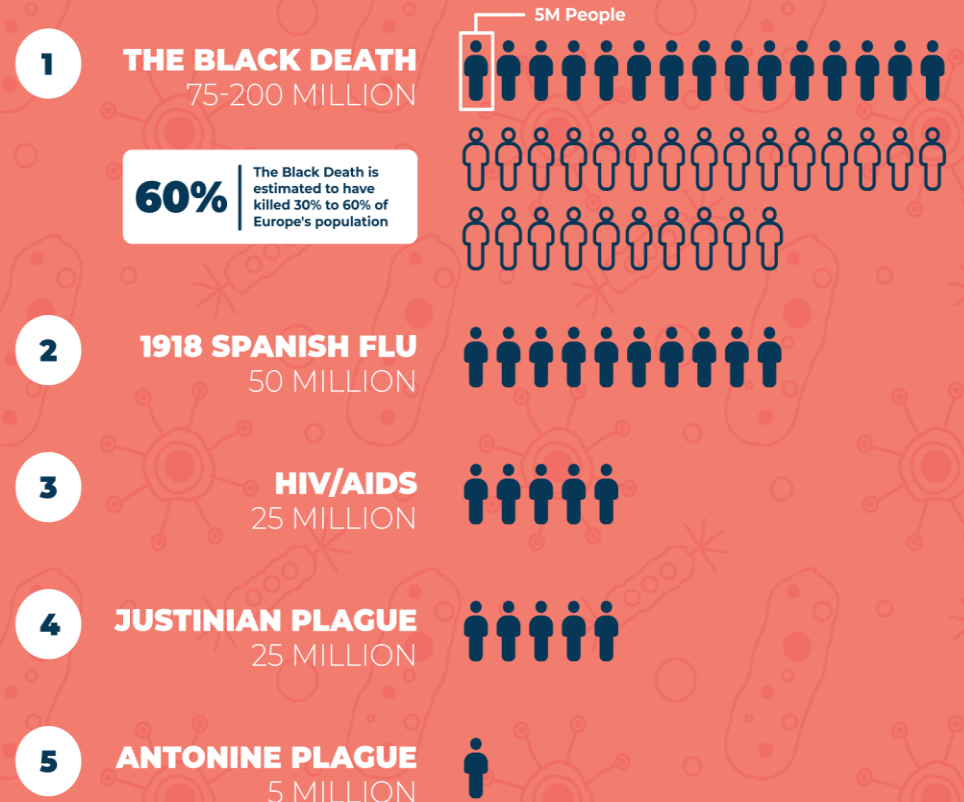
College students on the beaches of Florida during spring break look at these statistics compared to reported deaths from the coronavirus and ask: Why worry?

The answer is the impact of the Coronavirus is potentially far worse than the typical flu. The Spanish flu in 1918 killed 50 million people. The black death killed as many as 200 million people which at similar percentages would be over 1 billion people today. Another consideration is the reoccurrence potential. HIV is still killing people after decades. At best a vaccine is 18 months away from widespread use.

Investments such as HEPA filtered HVAC systems are long term investments. Such investments can take into account the potential for new pandemics in addition to COVID-19



# WORST PANDEMICS IN WORLD HISTORY



SOURCE: MPHONLINE.ORG

ALEXE LUCIAN | ALEXE.US

# Social Distancing for One Year is a Small Price to Avoid Spanish Flu but not Worthwhile for Swine Flu

If 5 billion people social distance for one year it would equate to a 10% reduction in life quality or 500 million life years.

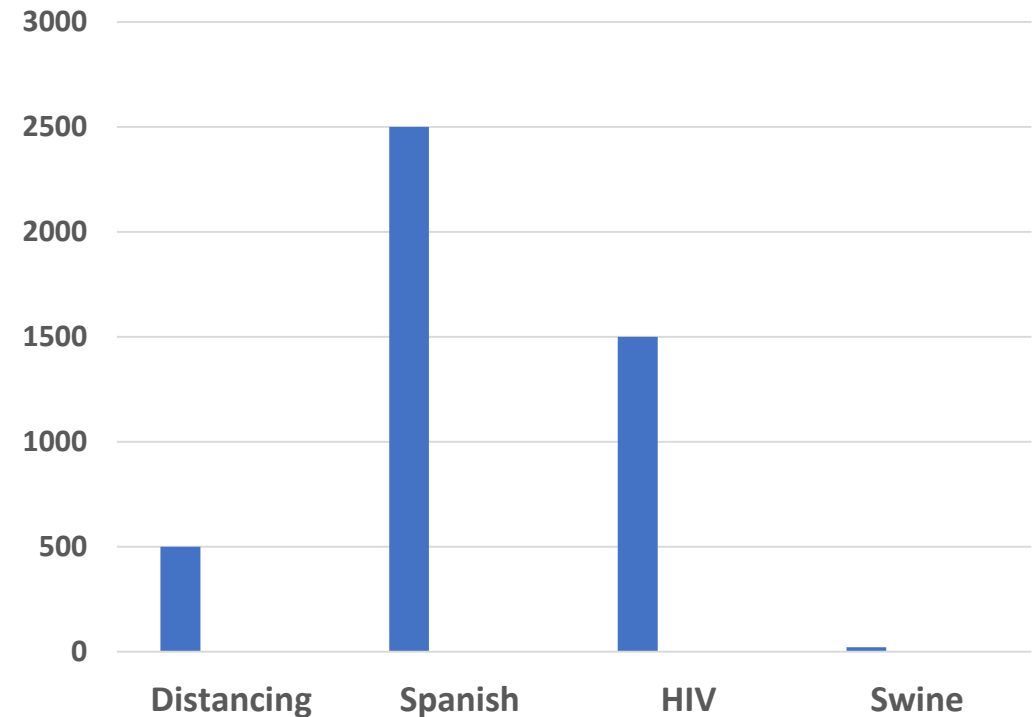
If the 50 million who died from the Spanish flu had lived another 50 years the total would be 2.5 billion life years.

The swine flu only killed 400,000 people who lost 20 million life years. Therefore the social distancing could be justified for two weeks but not one year to have avoided the swine flu.

However, this is a narrow view which takes into account the life quality for those who died. What about those who became ill and did not die. What about the families whose life was negatively impacted.

It can logically be argued that the total impact on life quality is 3x that of the impact on the individual patient who died.

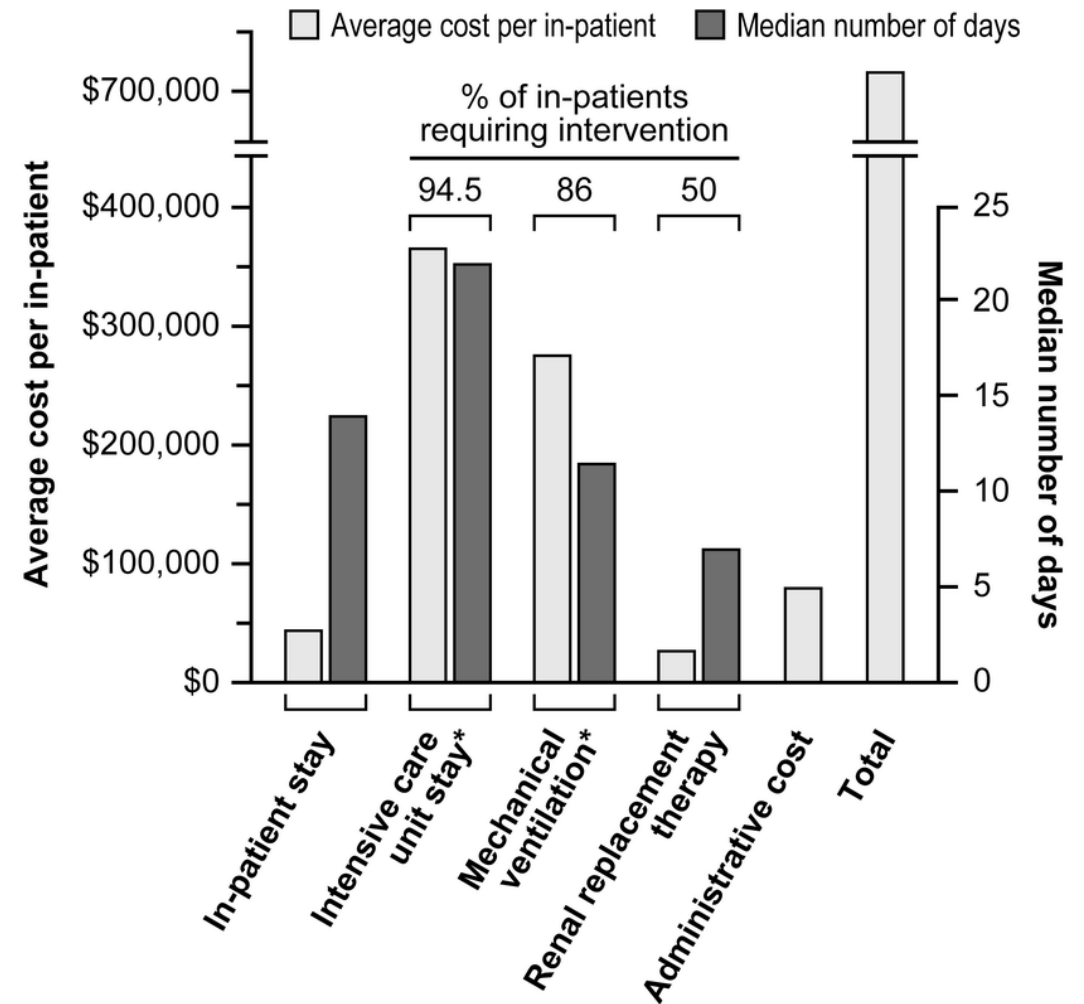
Million Life Quality Years-Patient Only



# Medical Care for a Coronavirus Patient can Exceed \$1 million

Estimation of major hospital costs affiliated with a MERS outbreak Average cost per day per in-patient (<http://kff.org/other/state-indicator/expenses-perinpatient-day/#>, <http://www.economist.com/blogs/graphicdetail/2013/06/daily-chart-18>) was multiplied by the median number of days for total cost per treatment.

In-patient stay: US average of \$3,145/day × 14 days median for a MERS in-patient = \$44,030.00; ICU stay: \* \$16,474 × 22 days = \$362,430; Mechanical ventilation: \*\$23,750 × 11.5 days = \$273,139; Renal replacement therapy: \$3,819 × 7 days = \$26,734; Total: sum of in-patient costs after multiplying by the percentage required and adding the additional administrative costs of \$79,150 per in-patient = \$713,942. An in-patient requiring all interventions would incur. This is only the hospital costs and not the total medical cost.



The total life quality impact of one patient death is the \$10 million plus \$19 million for 9 other patients who require varying amounts of medical treatment and loss of life quality for months and decreased productivity in society. These 10 patients also involve 50 family members and community contacts who suffer life quality reductions and lost productivity.

\$10 million for death

9 others infected at \$19 million

Family life quality impact for 50 people at \$1 million

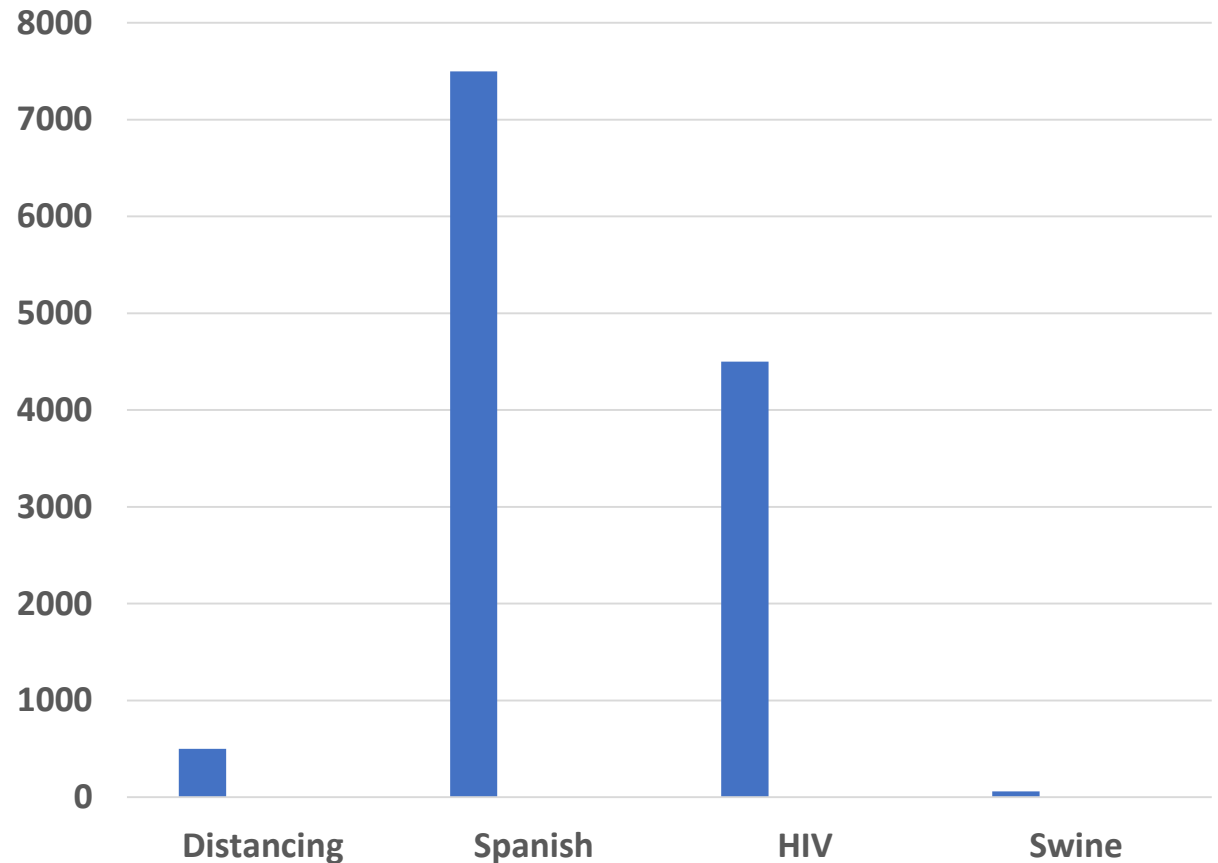
Total Life Quality impact per death is \$30 million



When the life quality impacts for all individuals are taken into account the social distancing for one year is a small penalty to pay except if the magnitude of the illness is equivalent to the swine flue. The negative impact is 60 million life years vs 500 million for social distancing of 5 billion people. Swine flu would therefore only justify social distancing for 600 million people for a year or all 5 billion people for a month.

The \$10 million per life lost amplified 3 times for the impact on life quality of others including those who become sick and do not die means that any proactive initiative by flow and treat suppliers which saves a life is worth \$30 million.

Million Life Quality Years all Individuals



Product	Life Quality Considerations
Hospital Isolation Room or Ventilator	Long term investment so a future value discount has to be applied. When will the next pandemic occur?
FAR UV disinfection	Save life now but may cause cancer later
Ozone space disinfection	Need to minimize danger to operators
Medical mask	Negative comfort aspects
N95 mask	More negative comfort aspects than medical mask
Room purifier	Inexpensive but question of effectiveness. Temporary rental by apartment owners in self isolation could be much more easily justified
HVAC system upgrade	May require new fan as well as HEPA and increase in energy consumption and more greenhouse gases
Foot Sanitizer	Relatively expensive so that applications with significant infection reduction have to be considered
Social distancing - individuals	Reduces life quality for large numbers of people
Country to country distancing	Tribal values play a big role in decision making by individual countries but there may be a realization that in our connected world we are one big tribe when it comes to virus mitigation

Product	Life Quality Considerations
Gowns - Wearing	The average hospital spends little compared to a pharmaceutical cleanroom. How does patient and medical worker safety compare to product safety?
Gowns - Disposal	Pharmaceutical protocols recognize contamination risks in disposal let alone reuse as is being practiced with the current shortage.
Gloves	Discomfort and inconvenience has to be compared to the benefits.
Sanitizing chemicals	Need to avoid dangers to maintenance workers or inhabitants but with future value discount e.g. there is a minor risk for cancer 30 years from now
UV robots	Cost versus performance being evaluated not only for hospitals but for hotels and airports
UV room purifiers	Effectiveness and byproducts are possible negatives
Hospital beauty	Positive life quality values have to be weighed against the negatives as repositories of germs
Filter media efficiency	There are grades of efficiency up to ULPA and also laminates with gas phase capture which need evaluation
Portable operating suites	Cost versus the frequency need in future emergencies

Product	Depreciated Investment/yr.	Narrow break even of benefits of patient lives saved per year	Holistic break even in number of lives saved per year
Isolation Room	\$4 million	0.4	.13
Foot Sanitizers	\$100,000	0.01	0.003
HVAC Upgrade	\$20 million including energy cost	2	0.7
Improved Gowning	\$50/day x 500 people x 365 days = \$9.1 million	0.9	0.3
Room Air Purifier	\$500	0.00005	0.00002

For an individual purchasing a room purifier the chances of contracting coronavirus could be 1 in 1000 and the odds that the room purifier would prevent it would be another 1 in 1000 . So the room purifier would have saved one person in a million (0.000001) or 1/20 of the needed breakeven point. But if the owner is in an apartment building where there is a self isolated tenant the odds might increase to 1 in 100 that the room purifier would provide the necessary protection. Also the odds of contracting disease may have increased to 1 in 100 with an infected tenant in the building. This brings the lives saved to 0.0001 and would justify the room air purifier by a 5 to 1 ratio.

Masks are a modest investment for a hospital and are proven to reduce hospital acquired infections. 100,000 visitors could also be given masks and the cost justified if it could save one life every 100 years.

	N95 Mask	Surgical Mask
Price \$	3	1
Number used per day - high	6	6
Yearly cost - high \$	4500	1500
Number used per day - low	1	1
Yearly cost - low	750	250
Hospital with 100 wearers Average yearly cost \$1000s	250	90
Break even lives saved at \$10 million per life	0.025	0.009
100,000 visitors/yr. wearing surgical masks \$1000/yr		100
Breakeven lives saved per year		0.01

# Innovation Potential Includes Life Quality Considerations

Flow and treat product and service suppliers can justify a lower total cost of ownership for their products by including not only the lives saved but other life quality aspects including comfort and even elimination of social distancing.

Innovation can be very lucrative in this new environment. Let's use the college student example on the beach. If they were drinking the pina coladas through N95 masks with a port to insert a straw they could minimize social distancing and still be protected. This seems ridiculous at first blush but remember in China the police are enforcing a rule that everyone in public place has to wear a mask.

It is not certain that these students would think that drinking while wearing an N 95 masks is any improvement in life quality over not being at the beach at all. On the other hand they wear hoodies in the summer time which could be viewed as equally uncomfortable. We are facing a new challenge. We need to receive input into what improves life quality from the individuals.

The potential is even greater for products and services which allow a plant to operate during this or future pandemics rather than close down. This is possible if

- Employees travel on public transportation which is sanitized and uses HEPA filtered air
- Employees wear masks during travel and throughout the work day as appropriate
- Plants adopt cleanroom technology as needed

## Hoodies or N95 Mask Life Quality Impacts have to be Decided by the Wearers

The hospitals are challenged with deciding who gets ventilators and who doesn't. When should a ventilator be removed from a dying patient if needed by one who can be saved? They are confronted by cleanroom experts who claim that hospital art, draperies and other beauty related features are hosts for germ growth. If they make visitors wear masks is it worth the social cost? Life quality considerations are unavoidable.

Hospitals have elaborate programs to decide on priorities of care. The selection based on Quality Adjusted Life Years is common but many also consider the contribution which will be made by the individual if he recovers. Hospitals have boards which wrestle with the various rating methods. Given the present shortage of ventilators this is a major challenge. But the main reason for the difficulty in decision making is the assumption that Noocracy or government by the wise is more applicable than direct democracy.

If the choice for a new heart is between a young prison inmate on suicide watch and a happy productive older individual the Noocrats might choose the inmate based on QALY. But the two individuals would likely both agree that the older person should have the heart

The democratic approach is actually fairly unambiguous. For example most people place a 25% premium on unhealthy activities such as eating ice cream and driving cars. They willingly choose an 80 year life with these enjoyments rather than extra 20 years without them. If self isolation is equivalent to the austere life style then each year lived this way is the equivalent of 3 months loss of life

It is not up to the Noocrats to determine the value of wearing hoodies or sipping pina coladas through an N95 mask. The democratic approach ascertains the collective desires of patients and acts accordingly. This concept was first introduced 9 years ago as part of a study for one of the largest healthcare companies. A detailed analysis was published in Health Care Development [http://home.mcilvainecompany.com/images/Quality\\_Enhanced\\_Life\\_Days.pdf](http://home.mcilvainecompany.com/images/Quality_Enhanced_Life_Days.pdf)



# Total Economic and Social Impact



Countries around the world are weighing the economic impact of isolation protocols vs the economic and social costs of increased infection without the protocols. This analysis has become a subject of considerable controversy when it was the subject of discussion by President Trump starting around March 21.

The U.S GDP is \$22 Trillion per year. Isolation could reduce the GDP by \$5 trillion or even more. As shown on the following slide the economic and social cost of one coronavirus death is close to \$56 million. One million additional deaths caused by a back to work protocol would have a \$56 trillion impact. The Spanish flue caused 50 million deaths around the world.

So a worst case scenario for the U.S. is millions of deaths. The challenge is that we will not know in advance how many deaths would result from a back to work protocol. Based on \$56 million value per life lost the break even point would be 89,000 additional lives lost for a \$5 trillion reduction in U.S GDP.

The weakness of this argument is the assumption that the economy would be humming along at full efficiency despite the rising death toll. A counter argument would be that there would still be a \$4 trillion loss with the back to work protocol. People who would be fearful for their lives and those of loved ones would not go to restaurants or perform their economic functions as they normally would. So this would bring the breakeven point down to just 18,000 lives. So any back to work strategy which results in more than 18,000 additional lives lost would be adverse to the economy and the country.

A proactive back to work strategy would use masks, filters, sanitization, and other technologies to allow people to return to work at an additional loss of life less than 18,000.

The total life quality impact of one patient death is the \$10 million plus \$19 million for 9 other patients who require varying amounts of medical treatment and loss of life quality for months and decreased productivity in society. These 10 patients also involve 50 family members and community contacts who suffer life quality reductions and lost productivity. This is just the life quality impact. The economic impact adds another \$26 million. So the combined life quality and economic impact is \$56 million. Any strategy which encourages return to work based on the economics needs to take these calculations into account.

\$10 million for death plus \$5 million in economic cost

9 others infected at \$19 million life quality costs and \$20 million in economic impact

Family life quality impact for 50 people at \$1 million plus \$1 million economic impact

**Total Life Quality plus Economic Impact per death is \$56 million**

## U.S. Deaths Likely to be 100,000 to 150,000

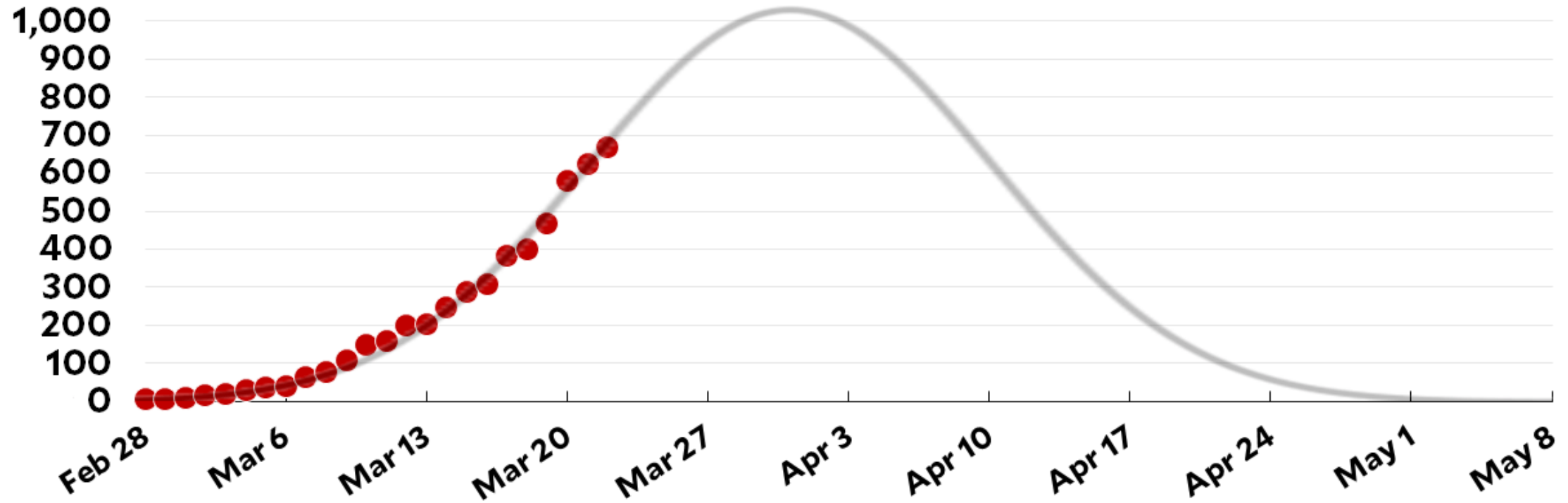
An analysis in *Mother Jones* based on the Italian experience has been used to predict deaths in the U.S. the assumption is that the growth and decline in deaths will show a similar curve and time frame.

In the following Italian graph, the first dot is the average daily death toll from February 24-28. The last dot is the average daily death toll from March 19-23. The author overlaid an eyeball fit of a normal curve, which suggests the death rate will peak in early April and the epidemic will end in early May. (There are other ways of charting the data, and they all point to the same thing: an early April peak and an early May finish.) The total number of deaths will be in the ballpark of 25,000, which amounts to 0.04 percent of their total population. If we take control measures seriously and follow the Italian path, the US epidemic will end a little later, in mid-May, and the total number of deaths will be around 100,000-150,000.

What would happen if there was a back to work protocol implemented in Early April. Could the death toll be 200,000 or 400,000 or higher? In any case it would seem that the economical and social cost of the back to work protocol would far exceed the economic benefit of higher production.

# Coronavirus Daily Death Rate

## Rolling 4-Day Average for Italy



Source: Johns Hopkins COVID-19 dataset as of March 23

Mother Jones

The fact that the coronavirus is in the early stages in most countries and is steeply rising indicates that the disease will continue to have a severe impact on the world for months to come.

In China there are few new cases. But there is worry that infections brought in by foreigners will start another epidemic. It is unlikely that there will be a vaccine which is effective and been widely distributed for at least 12 months.

The likelihood of future epidemics of similar impact will shape investment decisions for years to come.

**COVID-19 total cases and deaths by region**

